From: Rochlin, Kevin
Sent: Monday, March 24, 2014 10:26 AM
To: Greutert, Ed [USA]
Subject: FW: Test Gamma Cap Framework Document
Attachments: 2014-03-21 FMC Test Gamma Cap Framework.pdf

Categories: Lepic 3-22 to 4-4

From:

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Sent: Friday, March 21, 2014 3:30 PM
To: Rochlin, Kevin
Cc: Sheldrake, Beth; Greutert, Ed [USA]; Barbara Ritchie; Kelly Wright; susanh@ida.net; Bruce.Olenick@deq.idaho.gov; Douglas.Tanner@deq.idaho.gov; Scott.Miller@deq.idaho.gov; Jeff Hamilton; Marguerite Carpenter; David Heineck; Mike Steiner; Rob Hartman
Subject: Test Gamma Cap Framework Document

Kevin:

On behalf of FMC, I am submitting for your review the "Framework for Additional Test Gamma Cap Evaluation and Performance Verification" as discussed during the March 6, 2014 conference call.

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Framework for Additional Test Gamma Cap Evaluation and Performance Verification

As agreed during a March 6, 2014 conference call among EPA, DEQ, SBT, FMC and MWH representatives, this framework for additional field work has been developed to address EPA comments received on FMC's *Gamma Cap Performance Evaluation Report - November 2013* so as to fulfill the following goals:

- Determine the thickness of cover required to attain the gamma RAO
- Correlate collimated gamma count and exposure rate measurements so as to support development of a Performance Standard Verification method to be used following remedial construction

The proposed scope of activities includes the following:

1. Baseline measurements at the proposed location of the test gamma cap in the Western Undeveloped Area (WUA) as shown in Figure 1. This location was determined during the Supplemental Remedial Investigation (SRI) to be representative of background, i.e., not influenced by "gamma shine".

    a. As shown on Figure 2, make 10 baseline (plus one duplicate) co-located exposure and gamma count rate measurements on a triangular grid across the planned pad location, using a GE Model RSS-131 high pressure ionization chamber (HPIC) and Ludlum Model 44-10, 2-inch (in.) by 2-in. bare and collimated sodium iodide detector, coupled to a Ludlum 2221 ratemeter/scaler, respectively. The triangular grid will be implemented, based on guidance in the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM).

    b. Make the exposure rate measurements at 1 meter above the ground surface, every six seconds for three minutes. Record gamma count rates with the base of the collimator positioned on the ground and at 12 in. above the ground surface (ags); each for one minute, with the ratemeter/scaler set in scaler (integrated) mode. The detector sits at 6 and 18 in. ags in these collimated configurations. Record the bare detector measurements at 18 in. above the ground surface. The exposure rate measurements will be made at 1 m, given that the gamma RAO is established at this height. Three minutes is needed to acquire data beyond an initial approximately 1-minute spike in the instrument response to determine an average consisting of about 12 representative, individual measurements. If successful, the performance verification measurements made using a heavy, collimated sodium iodide detector need to be made at heights amenable to field personnel; namely on the ground or at 12 in. ags. Measurements made with the bare detector will be used to determine ratios of bare and collimated gamma count rates and to assess their consistency.

2. Construction and measurement of an infinitely thick slab of slag (uncovered pad):

    a. Construct a nominal 70- by 71- by 5-ft pad of slag in the WUA. The slag will be obtained from onsite sources. Determine radium-226 concentrations in five composite samples of the slag, by way of offsite laboratory analysis.

    b. Make one (plus one duplicate) co-located exposure; and bare and collimated gamma count rate measurement in the configurations outlined in Step 1(b) each day, at one point in the WUA when measurements are made on the test pad and gamma cap, to be used as part of the calculation of net radiological measurements.

    c. Make 10 (plus one duplicate), co-located exposure; and bare and collimated gamma count rate measurements on the uncovered pad, using the instruments and measurement frequency stated in Step b. The development of the number of measurements is described below.

3. Construction and measurement of soil cover over the pad:

    a. Repeat the co-located measurements on the soil cover after addition of a compacted 6-inch soil cap, 8-inch soil cap (2-inch lift), 10-inch soil cap (2-inch lift), 12-inch soil cap (2-inch lift), and 14-inch soil cap (2-inch lift).

    b. Develop correlations between the exposure and bare and collimated gamma count rate measurements, using the linear regression feature of MS excel, or equivalent. Determine the collimated gamma count rates for each position that is the predicted equivalent of the RAO (17.4 microRoentgens per hour). Determine ratios of bare and collimated gamma count rates and assess their consistency.

    c. Determine the minimum thicknesses of cover at which it serves to attain the RAO and is infinite, based on the exposure rate measurements made above the various lifts.

    d. The performance standards will be verified based on the correlation of exposure and gamma count rates measurements. The collimated gamma count rate that is the predicted equivalent to the RAO will be used as the relevant performance measurement.

Ten radiological measurement locations will be sited on the gamma test cap; a number developed using MARSSIM guidance.

The standard deviation, σ, for the 25 gross exposure rate measurements made in Configuration 3 (14.1 inches of cover, shielded by hay) of the October 2013 gamma test cap is 0.34. The shift, Δ (2.8 microRoentgens per hour [μR/hr]), is referred to in MARSSIM as the difference between the lower and upper boundaries of the grey region of the distribution of measurements which, in this case, is background (14.6 μR/hr) and the RAO (17.4 μR/hr), respectively. MARSSIM calls Δ/σ the relative shift. The calculated relative shift is 2.8/0.34, or 8.3.

The number of measurement locations, *N*, was determined using MARSSIM Equation 5-1

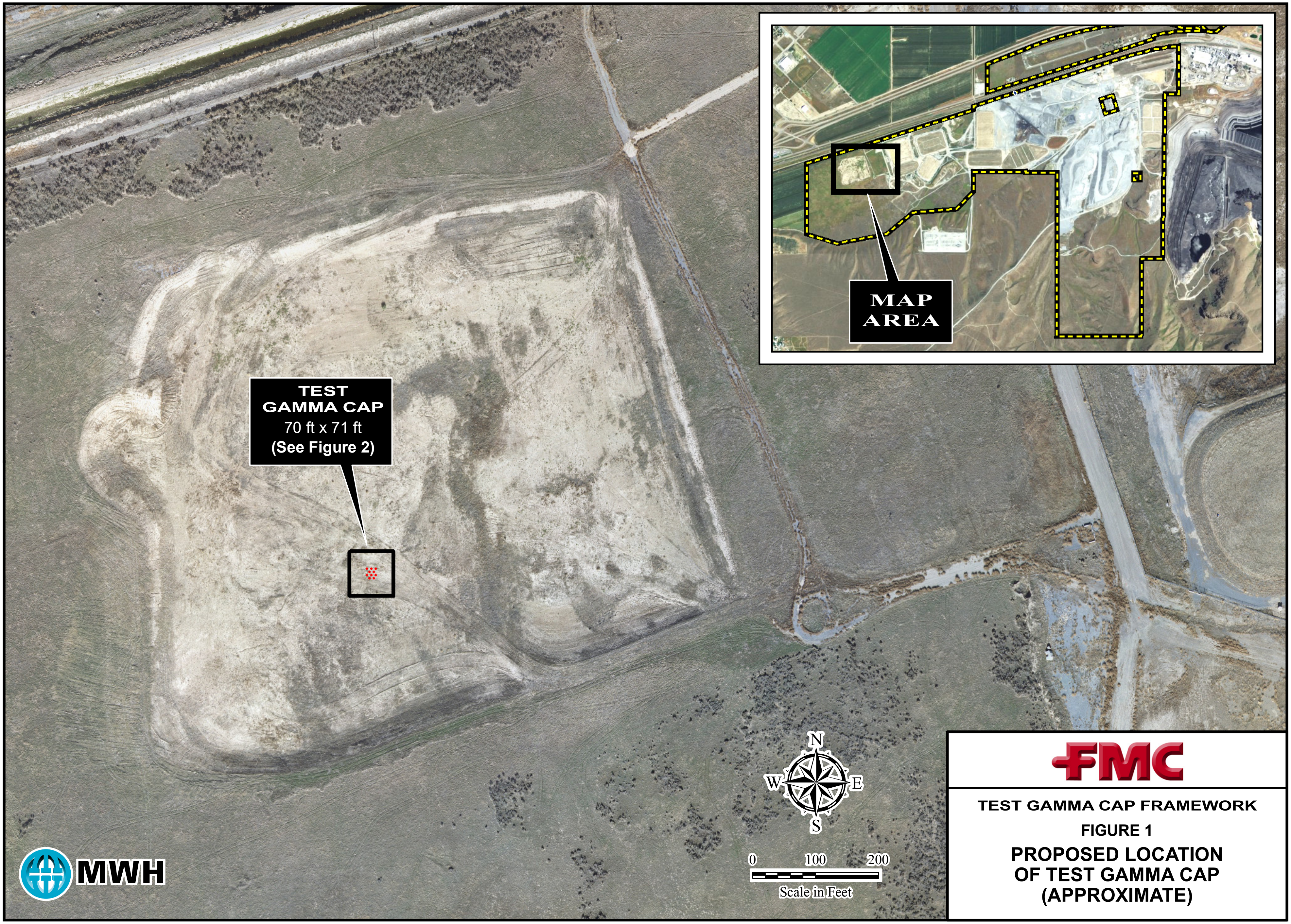
$$N = \frac{\left(Z_{1-\propto} + Z_{1-\beta}\right)^2}{3(P_r - 0.5)^2}$$

where *Z* (1.645) represents standard statistical values from a set of selected decision error levels. In this case, the Type 1 and Type 2 error rates are 5 percent: the associated value for *Z* is 1.645. P_r is the probability that a random measurement from the survey unit exceeds a random measurement from the reference area by less than the RAO, when the survey unit median is equal to the lower boundary of the grey region plus background. P_r is set at 1 for relative shifts greater than 4.

MARSSIM recommends adding a 20 percent factor to *N* for additional statistical power. The calculated *N* times 1.2, or 17, is the total number of measurements to be made on a theoretical reference area and each MARSSIM-defined survey unit. Half of 17, rounded up to 10, is the number to make in a theoretical reference area and each survey unit. In this case, there is only one survey unit; i.e., the gamma test cap.

Ten measurements is consistent with those listed in MARSSIM Table 5-3 with five percent error rates, for a lower, more conservative relative shift of 3.

FILE: I:\projects\FMCidaho\FMC_Gamma Cap Test Framework\FIGURES\Fig 1_FMC_Test Gamma Cap Framework_Mar2014_8x11.mxd DATE: 19 Mar 2014

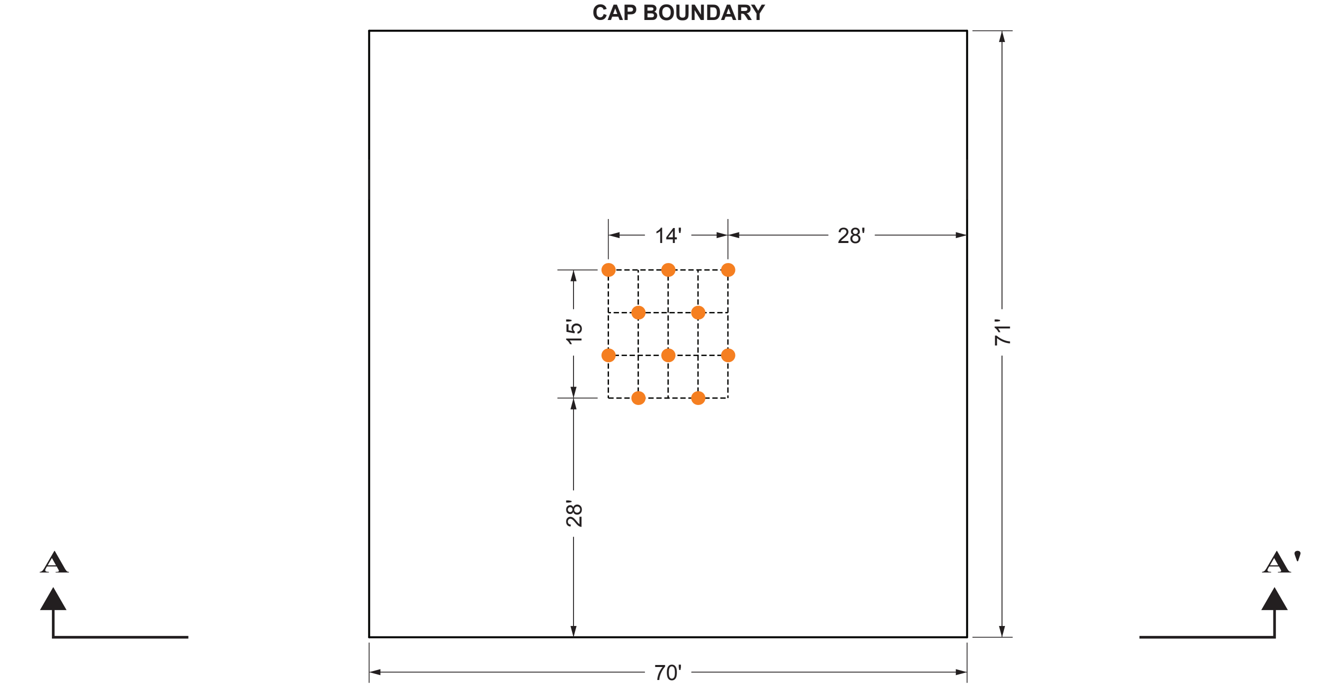


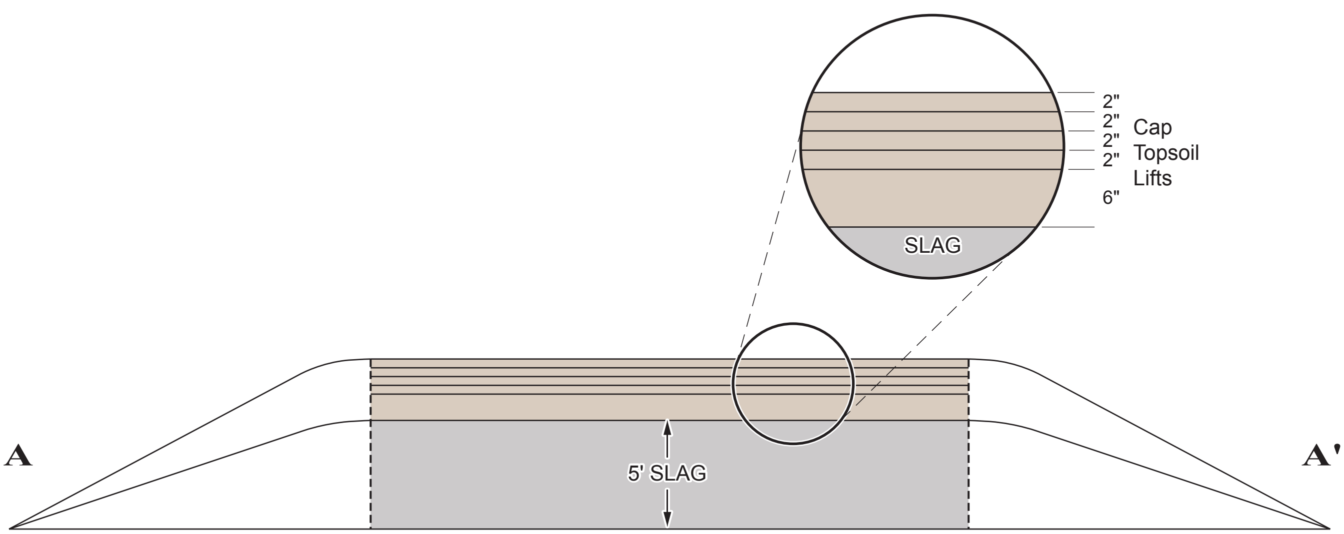
FMC

TEST GAMMA CAP FRAMEWORK

FIGURE 1

PROPOSED LOCATION
OF TEST GAMMA CAP
(APPROXIMATE)





CROSS SECTION A-A'
NOT TO SCALE

EXPLANATION

● Sample location

MWH

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TEST GAMMA CAP FRAMEWORK

FIGURE 2

PROPOSED TEST GAMMA CAP DETAIL

FILE Fig 2_Proposed Test Gamma Cap Detail_portrait.ai DATE: 20 Mar 2014